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A combined clinical-biochemical scoring of the newborn Results of the past four years

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In 1953 VIRGINIA APGAR was the first to introduce **clinical scoring of the newborn** [1]. The scoring system she introduced is now being used in almost every country. As with other similar clinical classification methods her system has the disadvantage of providing no exact measurable value and thus is prone to subjective influences.

The co-author of this article introduced fetal blood analysis [2]; he recommended as early as 1965 that — supplementary to this biochemical assessment of the fetus — in addition to the clinical scoring, the **pH-value in the umbilical artery blood be measured as a further parameter for the condition of the newborn** [3].

To obtain a better over-all view of the judgement of the newborn we split together with WULF [4] the clinical and the acidity score into groups (Fig. 2).

Since 1960 this acidity scoring has been employed at our clinic in all cases at risk in which fetal blood analysis (FBA) has been carried out; thus we have today a large number of newborn which have been observed in this manner (Tab. I).

The percentage of fetuses observed by FBA in 1961 was only 5.1%, rising to about 50% in the last years (Tab. I). The reason for this increase was that the indication for FBA was broadened from year to year by increasingly intensive methods of diagnosis, cardiotocography in particular.

At first we evaluated this large group of cases, to determine how many of the infants, supervised by using FBA, were born in an unsatisfactory condition. The percentage of such cases fell rapidly. However, since the number of infants supervised by FBA rose constantly, we did not feel justified in attributing the above decrease to improved clinical techniques alone. For this reason the complete clinical data had to be examined.

Curriculum vitae

HERBERT BOENISCH *was born in 1945 in Ranis/Thüringen and attended school in Berlin from 1953 to 1964. Afterwards he studied at the Free University of Berlin and passed state-board-examinations in medicine at the beginning of 1970. He obtained his degree as M. D. in 1972. From 1971 to 1972 he had been a member of the Unit Perinatal Medicine of the Free University of Berlin. Since the end of 1972 he is working at the children's clinic of Berlin-Neukölln.*

1. Data and methods

Our aim was to test **whether the increasingly better diagnostic and therapeutic advances of the past few years led to a decrease in morbidity** — i. e. fewer cases of acidosis and clinical depression.

Since July 1, 1970 for every child born in our department a clinical score (Fig. 1) was estimated [3] and the pH-value in the umbilical artery blood was registered. In the second half of 1970 the percentage of such **a combined clinical-**

Score	3	2	1	0
Cord	tight	—	moderately filled	flaccid
Trunk-color	pink	blue	pale blue	pale
Muscle tone, movements	strong, vigorous	good	reduced	absent
Respiration, first 1½ min	with frequent cries	undisturbed (rare or no cries)	disturbed, gasping	absent

Fig. 1. Scoring system modified by us in 1965 [3]. Score signs have to be judged immediately after delivery, respiration within 1½ minutes. A newborn baby in optimal condition scores 12 points.

Clinical score

Apgar	our system	clinical condition	symbol
9—10	9—12	optimal vigorous	C V
7—8	7—8	still vigorous	C IV
5—6	5—6	slightly depressed	C III
3—4	3—4	moderately depressed	C II
0—2	0—2	severely depressed	C I

Acidity score

umbilical artery pH act.	state of acidity	symbol
≧ 7.30	normal acidity	A V
7.20—7.29	slightly to moderately increased acidity	A IV
7.10—7.19	slight to moderate acidosis	A III
7.00—7.09	advanced acidosis	A II
< 7.00	severe acidosis	A I

Fig. 2. Grouping of scoring-systems relating the clinical condition and the acidity state of newborn [4].

biochemical scoring reached 83.8%, rising in later years to 97—99% of all living newborn.

The blood sample is taken immediately after delivery (before the first breath) from the umbilical artery. The pH-measurement is performed a few minutes thereafter in order to ensure that no change takes place in the composition of the blood sample and that buffer-treatment of the newborn can be introduced quickly.

All our data are based upon the actual pH-value.

Statistical calculations have been performed to test whether there were significant differences between 1970 and 1973; we set up four fould tables and applied the "chi-square-test" to them.

Tab. I. Number of labors monitored by fetal blood analysis. In 1960 we had only a few cases.

Year	Total No. of deliveries	No. monitored by FBA	Incidence of FBA
1961	2.347	120	5.1%
1962	2.539	289	11.4%
1963	2.776	287	10.3%
1964	2.726	465	17.1%
1965	2.680	568	21.2%
1966	2.709	703	26.0%
1967	2.586	743	28.7%
1968	2.499	626	24.9%
1969	2.514	776	30.9%
1970	2.501	1.043	42.2%
1971	2.391	1.225	51.7%
1972	1.821	907	50.3%
1973	1.683	796	47.4%

2. Results and discussion

The postnatal condition of the infants born in our clinic in the last four years as well as the particular method of delivery are shown in the following figures and tables.

We note throughout an almost continuous **decrease in cases of neonatal acidosis** (pH < 7.20) **and clinical depression** (score <7) (Fig. 3, Tab. II). This decrease is statistically highly significant (Tab. IV).

Cases of acidosis occurred in the last year in only 9.2%, clinical depression in 4.5%; 1.5% of the newborn suffered from acidosis as well as clinical depression.

The number of **vigorous infants** (pH ≧ 7.20 and clinical score ≧ 7) **rose correspondingly and significantly** in the same period (Fig. 4, Tabs. II and IV). In 1973 87.7% of the newborn were vigorous.

It is encouraging to note that the percentage of Cesarean sections has remained more or less the same (Fig. 7).

Also an examination of the data concerning the different methods of delivery shows on the whole a decrease in cases of acidosis and clinical depression (Figs. 5a—d, Tabs. III and IV). Fluc-

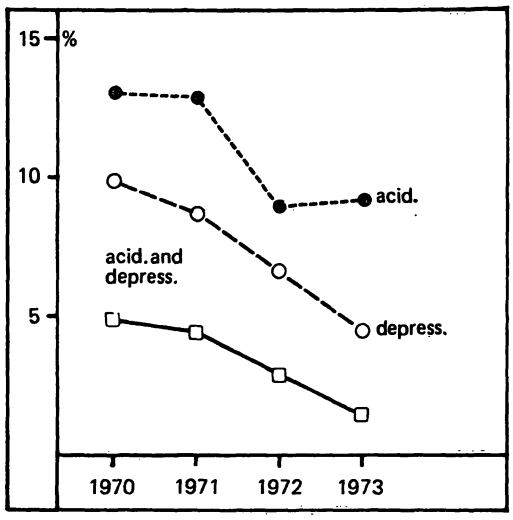

Fig. 3. Frequency of acidotic and depressed newborn in all cases scored.

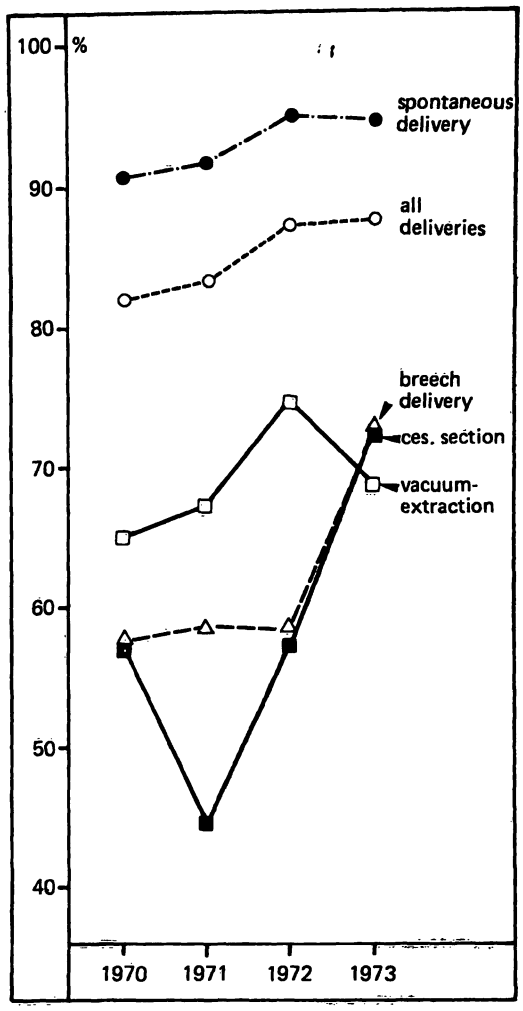

Fig. 4. Frequency of vigorous newborn depending upon particular type of delivery.

Tab. II. Status of the newborn from 1970 until 1973.

	1970		1971		1972		1973	
	No.	%	No.	%	No.	%	No.	%
living newborns	1243		2368		1802		1667	
scored babies	1042	83.8	2318	97.9	1760	97.8	1646	98.7
vigorous A > III/C > III	854	82.0	1921	82.9	1538	87.4	1444	87.7
acidotic A ≦ III	136	13.1	298	12.9	157	8.9	152	9.2
depressed C ≦ III	103	9.9	202	8.7	116	6.6	74	4.5
acidotic and depressed A ≦ III/C ≦ III	51	4.9	103	4.4	51	2.9	24	1.5
advanced or severe acidosis A ≦ II	46	4.4	73	3.2	35	2.0	21	1.3
moderately or severely depressed C ≦ II	37	3.6	62	2.7	54	3.1	24	1.5
both A ≦ II/C ≦ II	15	1.4	23	1.0	11	0.6	5	0.3

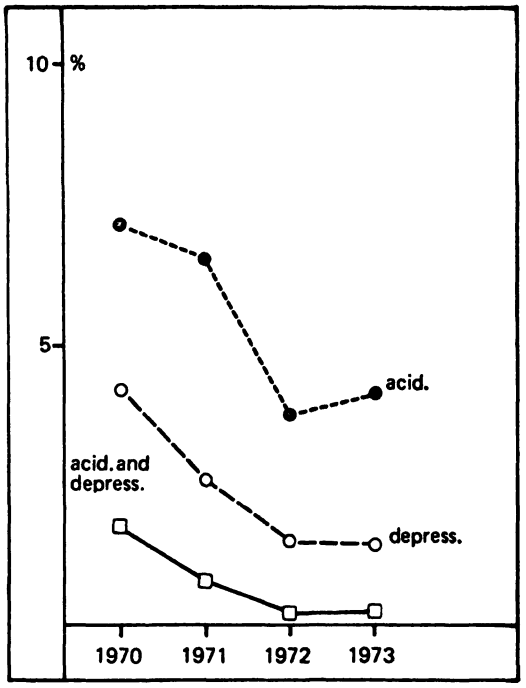

Fig. 5a. Frequency of acidotic and depressed newborn after spontaneous delivery.

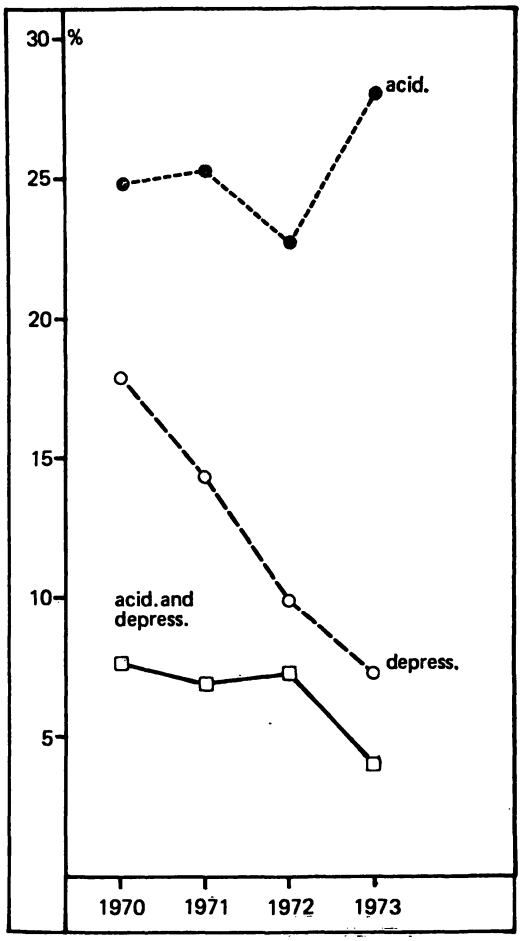

Fig. 5b. Frequency of acidotic and depressed newborn delivered by vacuumextraction.

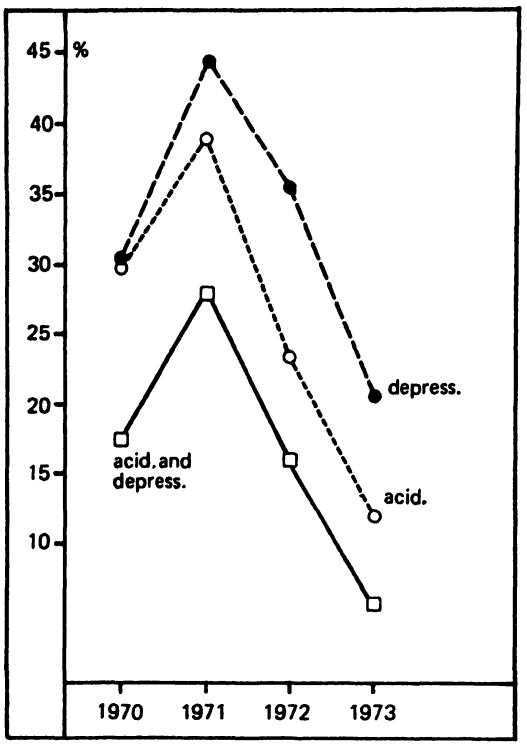

Fig. 5c. Frequency of acidotic and depressed newborn delivered by Cesarean section.

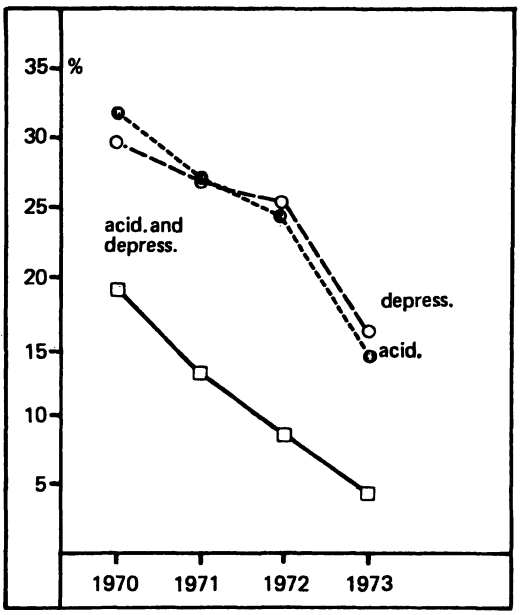

Fig. 5d. Frequency of acidotic and depressed newborn in breech delivery.

Tab. III. Status of the newborn and type of delivery.

	1970		1971		1972		1973	
	No.	%	No.	%	No.	%	No.	%
Spontaneous deliveries	740	71.0	1700	73.3	1296	73.6	1179	71.6
vigorous A > III/C > III	669	90.4	1557	91.6	1231	95.0	1116	94.7
acidotic A ≦ III	53	7.2	113	6.6	49	3.8	49	4.2
depressed C ≦ III	31	4.2	44	2.6	19	1.5	17	1.4
acidotic and depressed	13	1.8	14	0.8	3	0.2	3	0.3
Vacuum extraction	157	15.1	348	15.0	232	13.2	278	16.9
vigorous A > III/C > III	102	65.0	234	67.2	173	74.6	191	68.7
acidotic A ≦ III	39	24,8	88	25.3	53	22.8	78	28.1
depressed C ≦ III	28	17.8	50	14.4	23	9.9	20	7.2
acidotic and depressed	12	7.6	24	6.9	17	7.3	11	4.0
Cesarean sections	98	9.4	200	8.6	150	8.5	141	8.6
vigorous A > III/C > III	56	57.1	89	44.5	86	57.3	102	72.3
acidotic A ≦ III	29	29.6	78	39.0	35	23.3	18	12.8
depressed C ≦ III	30	30.6	89	44.5	53	35.3	29	20.6
acidotic and depressed	17	17.4	56	28.0	24	16.0	8	5.7
Breech deliveries	47	4.5	70	3.0	82	4.7	48	2.9
vigorous A > III/C > III	27	57.5	41	58.6	48	58.5	35	72.9
acidotic A ≦ III	15	31.9	19	27.1	20	24.4	7	14.6
depressed C ≦ III	14	29.8	19	27.1	21	25.6	8	16.7
acidotic and depressed	9	19.1	9	12.9	7	8.5	2	4.2

tuations occurring in some groups of operatively delivered infants are probably caused by the small number of cases. The few forceps deliveries are included in the group "vacuum extraction"; we did not deem it necessary to record these few cases (less than 10 per year) in an individual group.

Of course an infant born with slight acidosis and/or clinical depression is not always in considerable danger. Therefore we set the limits higher and included all children born with advanced or severe acidosis (pH < 7.10) and moderate or severe clinical depression (score < 5). Even in this especially selected group we noticed a pronounced and highly significant decrease in the above cases (Fig. 6, Tabs. II and IV). **In 1973 1.3% of all newborn had advanced or severe acidosis, 1.5% moderate or severe clinical depression and 0.3% both in combination.**

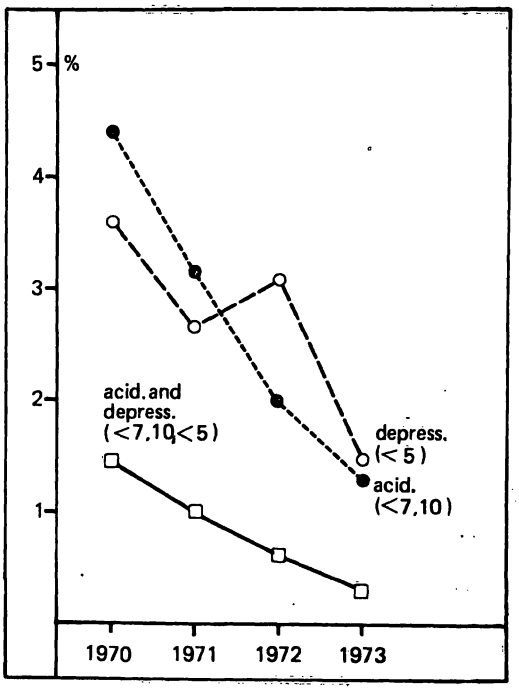

Fig. 6. Frequency of newborn with advanced or severe acidosis and moderate or severe clinical depression.

Tab. IV. Difference between 1970 and 1973. Calculation of significance*.

1) All newborns (s. Fig. 3, 4, 6)

acidosis	$p < 0.005$	
depression	$p < 0.001$	
acidosis and depression combined	$p < 0.001$	
vigorous newborn	$p < 0.001$	
advanced or severe acidosis	$p < 0.001$	
moderate or severe depression	$p < 0.001$	
acidosis (A <II) and depression (C <II) combined	$p < 0.005$	

2) Spontaneous deliveries (s. Fig. 4, 5a)

acidosis	$p < 0.005$	
depression	$p < 0.001$	
acidosis and depression combined	$p < 0.005$	
vigorous newborn	$p < 0.001$	

3) Vacuum extraction (s. Fig. 4, 5b)

acidosis	$p > 0.05$	(n. s.*)
depression	$p < 0.005$	
acidosis and depression combined	$p > 0.05$	(n. s.*)
vigorous newborn	$p > 0.05$	(n. s.*)

4) Cesarean section (s. Fig. 4, 5c)

acidosis	$p < 0.005$	
depression	$p > 0.05$	(n. s.*)
acidosis and depression combined	$p < 0.01$	
vigorous newborn	$p < 0.05$	

5) Breech deliveries (s. Fig. 4, 5d)

acidosis	$p > 0.05$	(n. s.*)
depression	$p > 0.05$	(n. s.*)
acidosis and depression combined	$p < 0.05$	
vigorous newborn	$p > 0.05$	(n. s.*)

* There is a significant difference when "p" is less than 0.05. The non-significant differences are marked.

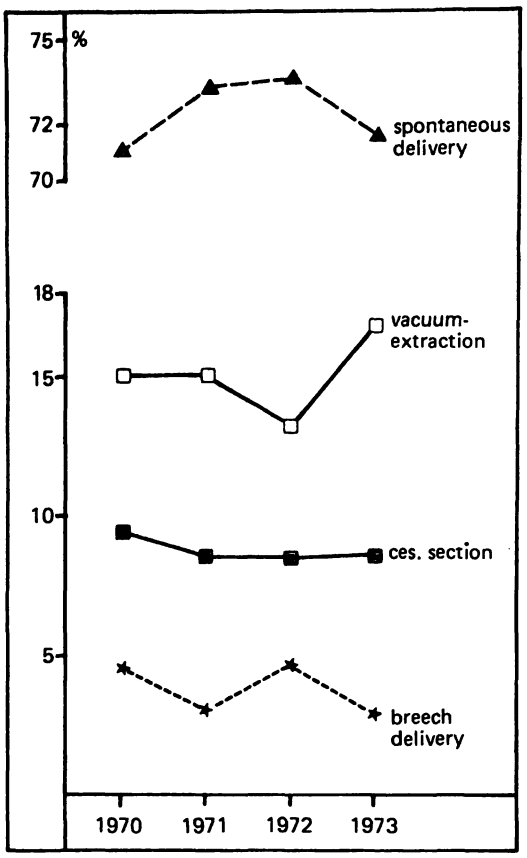

Fig. 7. Distribution of the different types of delivery.

This group of cases must be considered to be particularly endangered. The number of these infants must definitely be further reduced.

3. Conclusions

In progressive obstetrics the reduction of morbidity must today be emphazised more and more. We have to decrease the number of infants with cerebral damage, resulting from hypoxic injury in late pregnancy and during delivery. Because of its dependability for assessing neonatal condition and the objectivity of the pH-value from the umbilical artery blood, this parameter should be included in every evaluation of the newborn infant. Thus we were able to make better comparisons of the results from different departments.

Summary

Since July 1, 1970 for every infant born in our clinic we have recorded a **combined clinical-biochemical score.** In the present article these data were examined. The question for us was, whether the condition of the newborn immediately after birth has improved in the last years.

The clinical and the acidity score were divided into groups [4], as can be seen in **Fig. 2.**

We have shown, that the **number of infants with acidosis** (pH < 7.20) **and clinical depression** (score < 7) **has decreased with statistical significance (Fig. 3, Tabs.**

II and IV). Cases of acidosis occurred in the last year in only 9.2%, clinical depression in 4.5%; 1.5% of the newborn suffered from acidosis as well as clinical depression.
During the same period the **number of vigorous newborn** (pH ≧ 7.20 and clinical score ≧ 7) **increased significantly (Fig. 4, Tabs. II and IV).** In 1973 87.7% of the newborn were vigorous.
The number of infants with advanced or severe acidosis (pH < 7.10) and/or moderate or severe clinical depression (score < 5) decreased significantly. **In 1973 1.3% of all neonates had advanced or severe acidosis, 1.5% moderate or severe clinical depression and 0.3% both in combination (Fig. 6, Tabs. II and IV).** Also in respect to the different types of delivery a similar trend is shown **(Figs. 5a—d, Tabs. III and IV).**
The frequency of Cesarean sections has remained approximately the same during this period **(Fig. 7).**
Because of its dependability for assessing neonatal condition and its objectivity, the acidity score should be included in every evaluation of the newborn infant.

Keywords: Acidosis, Apgar-score, cardiotocography, depression, fetal blood analysis, monitoring (fetal), morbidity, newborn, score (biochemical), score (clinical).

Zusammenfassung

Kombiniertes klinisch-chemisches Zustandsschema des Neugeborenen. Ergebnisse 1970 bis 1973.

Seit dem 1. 7. 1970 erfolgte an unserer Klinik in der Regel bei jedem Neugeborenen eine **kombinierte klinisch-biochemische Zustandsdiagnostik.** In der vorliegenden Arbeit wurde das gesamte bis jetzt vorhandene Material einer Untersuchung unterzogen; für uns stellte sich die Frage, ob im Laufe der letzten Jahre im Zustand der Neugeborenen unmittelbar post partum eine Besserung eingetreten ist. Der klinische und der Aziditäts-Status wurden in Gruppen eingeteilt [4], **(Fig. 2).** Wir konnten zeigen, daß die **Anzahl der azidotischen und der klinisch deprimierten Neugeborenen in den letzten Jahren statistisch signifikant abgenommen hat (Fig. 3, Tab. II und IV).** Azidosen (pH < 7,20) kamen zuletzt nur noch in 9,2%, klinische Depressionen (Punkte < 7) in 4,5% der Fälle vor. 1,5% der Neugeborenen waren sowohl azidotisch als auch klinisch deprimiert.
Im gleichen Zeitraum **stieg die Anzahl der lebensfrisch geborenen Kinder (pH ≧ 7,20 und ≧ 7 Punkte) signifikant an (Fig. 4, Tab. II und IV).** 1973 waren 87,7% der Neugeborenen lebensfrisch. Die Fälle, in denen Kinder mit fortgeschrittener oder schwerer Azidose (pH < 7,10) bzw. mittelschwerer und schwerer klinischer Depression (Punkte < 5) geboren wurden, nahm signifikant ab. **1973 hatten 1,3% aller Neugeborenen eine fortgeschrittene oder schwere Azidose, 1,5% einen mittelschweren oder schweren Depressionszustand und 0,3% beides in Kombination (Fig. 6, Tab. II und IV).**
Auch bei Aufschlüsselung in die verschiedenen Geburtsarten ist ein ähnlicher Trend erkennbar **(Fig. 5a—d, Tab. III und IV).**
Die Häufigkeit der Schnittentbindung ist während dieser Jahre etwa gleich geblieben **(Fig. 7).**
Wegen seiner großen Aussagekraft und der Objektivität sollte die Beurteilung des Aziditäts-Status bei keiner Zustandsdiagnostik des Neugeborenen fehlen.

Schlüsselwörter: Azidose, Apgar Punkteschema, Depression, Fetalblutanalyse, Kardiotokographie, Morbidität, Neugeborenes, Punkteschema (biochemisch, klinisch), Überwachung (intrapartuale).

Résumé

Schème clinico-chimique combiné sur l'état des nouveaux-nés. Résultat 1970—1973.

Depuis le 1. 7. 1970 il était devenu de règle dans notre clinique de procéder à un **diagnostic clinico-chimique combiné sur l'état de chaque nouveau-né.** Le présent article porte sur l'analyse de toutes les observations effectuées jusque là, avec pour object principal de savoir si l'état des nouveaux-nés aussitôt post partum s'était amélioré au cours des ans. Les status clinique et d'acidité ont été classés et ordonnés [4], **(Fig. 2),** ce qui a permis d'observer que **le nombre des nouveaux-nés acidosiques et des nouveaux-nés en mauvais état clinique a diminué de façon statistiquement significative au cours des dernières années (Fig. 3, Tab. II et IV).** Les acidoses (pH < 7,20) n'apparurent plus que dans 9,2% des cas, et les dépressions cliniques (points < 7) dans 4,5% des cas. 1,5% des nouveaux-nés étaient aussi bien acidosiques que dans un mauvais état clinique.
Durant la même période, **on observa une hausse significative du nombre des enfants nés en parfait état de santé** (pH ≧ 7,20 et ≧ 7 points) **(Fig. 4, Tab. II et IV).** En 1973, 87,7% des nouveaux-nés étaient sains. Les cas de naissance d'enfants avec acidose avancée ou grave (pH < 7,10) ou, respectivement, dépression clinique de degré moyen à grave (points < 5) diminuèrent de façon significative. **En 1973, 1,3% de tous les nouveaux-nés avaient une acidose avancée ou grave, 1,5% un état dépressif moyen ou grave et 0,3% les deux combinés (Fig. 6, Tab. II et IV).**

Même une classification selon les diverses formes de naissance révèle une tendance similaire **(Fig. 5a—d, Tab. III et IV).**

La fréquence des césariennes est restée à peu près la même durant ces années **(Fig. 7).**

En raison de son importante signification et par souci d'objectivité, l'appréciation du status d'acidité ne devrait jamais être omise dans les diagnostics relatifs à l'état des nouveaux-nés.

Mots-clés: Acidose, schème de points Apgar, dépression, analyse du sang foetal, cardiotocographie, morbidité, schème par points pour le nouveau-né (biochimique, clinique), surveillance (intrapartuale).

Bibliography

[1] Apgar, V.: A proposal for a new method of evaluation of the newborn infant. Curr. Res. Anesth. 32 (1953) 260

[2] Saling, E.: Neue Untersuchungsmöglichkeiten des Kindes unter der Geburt (Einführung und Grundlagen). Geburtsh. u. Frauenheilk. 21 (1961) 905

[3] Saling, E.: Zustandsdiagnose beim Neugeborenen unmittelbar nach der Geburt. Gynaecologia 160 (1965) 133

[4] Saling, E., K. H. Wulf: Zustandsdiagnose beim Neugeborenen. Gruppeneinteilung. Fortschr. Med. 89 (1971) 12

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